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Principal Investigator: Toktay, Beril .

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Organization: GA Tech Res Corp - GIT

Submitted By:

Toktay, Beril - Principal Investigator

Title:

WORKSHOP - Recovered Materials: Inter-Industry Synergy Workshop

Project Participants

Senior Personnel

Name: Toktay, Beril

Worked for more than 160 Hours: Yes

Contribution to Project:

Post-doc

Graduate Student

Undergraduate Student

Technician, Programmer

Other Participant

Name: Recovery Effort, Carpet America

Worked for more than 160 Hours: Yes

Contribution to Project:

CARE was contracted to collect and analyze industry data, and to conduct the interviews necessary to develop a blueprint for the improved recycling of renovation debris in the state of Georgia. The output was a white paper discussed in the industry workshop held at the Georgia Institute of Technology on September 5, 2008. They also assisted in the organization of the workshop.

Research Experience for Undergraduates

Organizational Partners

CARE, Carpet America Recovery Effort

The Executive Director of CARE is the industry liaison and is assisting in generating industry contacts and workshop organization.

Other Collaborators or Contacts

The workshop forged relationships with panelists and participants, some of whom are interested in continuing to collaborate on a deconstruction materials reclamation pilot.

Activities and Findings

Research and Education Activities: (See PDF version submitted by PI at the end of the report)

The goal of the Renovation Debris Recycling

Inter-Industry Synergy Workshop was to develop a systems-level understanding of renovation recycling, focusing in particular on leveraging synergies across industries (resilient flooring, carpet, drywall, ceiling tile) and the value chain (builders, haulers, recyclers, etc.). The seventy-five invitees represented the following sectors: academia (25%); manufacturing (23%); reclamation (20%); government/public sector (20%); construction (7%); and, other (5%). The forty-four workshop attendees represented manufacturing (30%); reclamation (21%); government/public sector (16%); academia (16%); construction (9%); and other (8%). The unique systems approach we took leveraged Georgia Tech's expertise on closed-loop supply chains that is distributed in the Colleges of Management and Engineering.

To facilitate the dialogue between participants, we prepared and sent a white paper ahead of time to invitees. The workshop was structured to elicit input from all participants through a mix of industry testimonials, best practice presentations, policy presentations, and breakout group discussions. The workshop program is attached as a pdf file.

Findings: (See PDF version submitted by PI at the end of the report)

The workshop not only served to disseminate resident knowledge to participants from industry, academia, and public entities, but also generated excellent discussion among participants. The Findings document in attachment summarizes the major issues that emerged at the workshop as pressing systems-level needs, as well as potential avenues for more synergistic reclamation practices.

Training and Development:

Part of the input to the white paper came from a student group project assigned in Dr. Toktay's graduate-level Business and Environment course. These students benefited by learning about industry (doing background research and interviewing relevant parties) as well as applying the frameworks they learned in class to synthesize the information they collected.

The students who participated in the workshop itself benefited greatly from seeing both the industry perspective and the interdisciplinary perspective. They also had an opportunity to talk about their work and interact with participants during the workshop.

The workshop forged stronger research partnerships among the faculty involved, and among faculty and participants. For example, Drs. Toktay, Realf and Patterson are collaborating on an article concerning renovation recycling targeted at the Journal of Industrial Ecology, with input from collaborator Bob Peoples and participants Michael Buono and Matt McKinney.

Outreach Activities:

The workshop itself constitutes a significant outreach activity involving industry and government.

The world wide web was used to disseminate the workshop, the white paper, and the workshop findings to the broader public.

The workshop was partially videotaped and CDs were made available to participants and other interested parties. The organizers plan to use some of the discussions in these CDs for classroom instruction in related courses.

A survey tool was designed to obtain input from participants. Overall, respondents rated the workshop as valuable to their organizations with an average score of 4.05 (out of 5).

Comments from the evaluation included:

- Good to hear other states and business perspective
- The workshop broke new ground in cooperative inter-industry communication and understanding and was beneficial on many levels.
- Good networking and awareness of other material challenged areas. Hopefully, the follow up will allow some cross pollination of solutions and failures.
- Good combination of industries and view points

All respondents said they wanted to be kept informed of future activities related to this project, and 91% were interested in being involved in a pilot project that uses the ideas generated in this workshop to increase renovation debris recycling.

Journal Publications

Books or Other One-time Publications

Lynn Patterson and Beril Toktay, "Maximizing Renovation Recycling Through Industry Cooperation", (2008). White Paper,
Bibliography: Georgia Institute of Technology Working Paper

Web/Internet Site

Other Specific Products

Contributions

Contributions within Discipline:

The project generated deeper insights into operational and supply chain issues associated with renovation materials recycling.

Contributions to Other Disciplines:

The workshop was unique in bringing together participants with expertise in management, engineering, public policy, and economic development. It forged interdisciplinary collaborations as described above.

Contributions to Human Resource Development:

The workshop gave all participants an opportunity to interact with parties they do not usually interact and broadened their perspective.

Contributions to Resources for Research and Education:

Opportunities were identified and acted on concerning collaborative interdisciplinary research.

Contributions Beyond Science and Engineering:

The workshop generated many ideas and enthusiasm for renovation recycling. Inter-industry synergies emerged as the participants were able to brainstorm potential solutions together. The next steps for cultivating the synergies are (1) to invite additional stakeholders to further develop solutions; (2) to develop a pilot program where the value chain puts into action the recommendations developed; and (3) to support innovation in renovation material reuse and recycling. These directions hold great promise in reducing the environmental impact of renovation waste and for creating economic development opportunities.

Categories for which nothing is reported:

Any Journal

Any Web/Internet Site

Any Product

Inter-Industry Synergy Renovation Debris Recycling Workshop Agenda
Georgia Institute of Technology
College of Management Room 312
September 5, 2008

7:30 - 8:00 am	Registration and Continental Breakfast (provided)
8:00 - 8:15 am	Welcome, Introduction, Charter (Bob Peoples and Beril Toktay)
8:15 – 8:45 am	Review of White Paper (Lynn Patterson)
8:45 – 10:15 am	Breakout Group Industry Representation Testimonials: What are the obstacles to recycling renovation debris and what would it take for my business/my industry to recycle more renovation debris? Carpet manufacturer (Eric Nelson, Interface; Russ DeLozier, Shaw Industries) Ceiling tile manufacturer (Anita Snader, Armstrong) Drywall manufacturer (Pace Pickel, USG; Brad Nemeth, USG) Resilient flooring manufacturer (Diane Martel, Tarkett; Dean Thompson, RFCI) Construction (Winston Williams, Turner Construction; Chris Ryan, Hogan Construction) Recycling Operators (Matt McKinney, IRN; Cynthia Poselenzny, Patterson Services) Government (Anthony Spencer, Fulton County, Valena Scott, Sustainable Atlanta) Group Discussion of top three barriers and opportunities for recycling (Bob Peoples and Matthew Realff)
10:15 – 10:30 am	Break
10:30 – 11:45am	Policy Into Practice (Lynn Patterson): Federal Perspective (Steve Smith – EPA) A Georgia Perspective (Roy Edwards – P2AD) The Local Government Perspective (Mary Williams – City of San Francisco)
11:45 – 12:45 pm	Lunch (provided)
12:45 – 1:45 pm	Best Practices (Jeremy Stroop) Mike Buono – Environmental Services Management Group Jim Birmingham – Waste Management
1:45 – 2:45 pm	Parallel breakout sessions: Identify synergies (Bob Peoples, Matthew Realff, Beril Toktay, and Jeremy Stroop)
2:45 – 3:00pm	Break
3:00 – 4:00 pm	Breakout groups report and discussion (Bob Peoples, Matthew Realff, Beril Toktay, and Jeremy Stroop)
4:00 - 4:30 pm	Review, discuss outcomes, next steps, assign actions for follow-up (Bob Peoples and Beril Toktay)
4:30 pm	End of Workshop. Thank you!

Findings:
Renovation Debris Recycling
Inter-Industry Synergy Workshop

College of Management
Georgia Institute of Technology
Atlanta, Georgia
September 5, 2008

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Any opinions, findings, or conclusion are those of the authors and do not
reflect the views of the National Science Foundation.

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Background

With continued building and renovation of America's cities, construction, demolition & renovation (CD&R) materials are generated at an increasing rate; creating a strain on the United States' physical and financial infrastructure, and environmental resources. Comprising approximately half of the total national waste stream, CD&R debris can be perceived either as an obstacle or an opportunity to private entrepreneurs and public agencies. The obstacle is the sheer volume of materials¹ – between 25 and 45 percent of the total waste stream and in excess of 150 million tons per year² – crowding landfills. The opportunity lies in discovering ways to harness economic power and conserve natural resources by returning CD&R debris to market as inputs to manufacturing activity or as reusable materials.

Increasing interest in recycling CD&R materials stems from a variety of sources, including the green building movement, sustainable business practice models, and resource conservation programs. However, these recycling efforts are in their infancy and face daunting logistical, market, and policy barriers. Ultimately, these barriers thwart the maximization of the recovery of these materials. Past experience with developing market-based solutions for the reuse and recycling of post-consumer materials suggests that lack of synergy across different post-consumer material types and lack of collaboration across different levels in the value chain are significant barriers to driving down costs and increasing recycling rates. Thus, it is essential to uncover the reasons why CD&R recycling is a challenge to each industry and to help stimulate ideas on how to achieve potential synergies.

Purpose of workshop

This project focused on renovation recycling as a subset of C&D recycling. Renovation recycling has unique characteristics compared to whole-building recycling. These characteristics involve space constraints for separation of material, minimizing disruption to existing or neighboring occupants, and specialized materials (concrete v. carpet for example). To deepen the systems-level understanding of renovation recycling, including barriers, best practices, and supplies and demand of renovation recycling materials, the Renovation Recycling Inter-Industry Synergy workshop sought the participation of academicians and practitioners from the renovation recycling value chain. The value chain was represented by participants from the reclamation and recovery, processing, manufacture, and government sectors.

¹ Data on C&D debris are difficult to obtain with many estimates over a decade old (for example, the 1998 Waste Characterization study by the EPA). This does not account for the turn of the century housing boom, the increase in tenant improvements, or new ways of handling waste. One of the more recent estimates suggests that demolition generates approximately 115 million tons of debris per year (Gershman, Brickner & Bratton, Inc., 2006)

²Chartwell Information, 2003

Summary of workshop activities

The Renovation Recycling Inter-Industry Synergy Workshop was held at Georgia Institute of Technology College of Management on September 5, 2008. Forty-two participants, representing material recovery, manufacturing, academia and government participated in the highly interactive carpet, resilient flooring, ceiling tile, and drywall industries (Appendix A). The structure of the workshop included presentations to the group as a whole and breakout sessions where participants were asked to share their experiences and brainstorm potential solutions. The morning sessions were devoted to situational analysis and problem assessment. The midday sessions included presentations by two groups: (1) government representatives detailing policies and programs that supported CD&R recycling and (2) recycling contractors who presented best practice cases. The afternoon sessions focused on developing solutions to overcome the barriers for renovation recycling. Each of the sessions is detailed below.

Situational analysis and problem assessment from morning sessions

In their opening remarks, the co-chairs of the workshop charged the participants with the task of the workshop: to develop a blue print (process, policy or business model) that would substantially increase the recycling rate of renovation debris. While developing this blueprint, the participants were asked “are there synergistic opportunities along the value chain or between sectors that can be exploited?” An overview of the white paper (distributed in advance to the meeting) was presented to provide all participants with a common starting point. The participants were then assigned to two breakout groups.

In each of the breakout groups, representatives from each of the major industries and government presented a summary of the barriers to renovation recycling from their industry’s perspective. Regardless of the industry, several recurring themes from the breakout sessions emerged as barriers to recycling:

- Renovation Logistics Costs

Logistical barriers include transportation costs, lack of space for material staging, working in confined spaces, and hauler mindsets for land-filling versus recycling.

- Source Separation Costs

Separation of materials at the site incurs higher costs due to co-mingling and contamination of materials.

- Infrastructure Costs

With inadequate infrastructure, costs for renovation recycling increase. These costs stem from required training, additional hours required for manual labor, inefficient requirement design, limited collection and processing facilities, and overall lack of economies of scope and scale.

- Communications

Lack of communications or knowledge of recycling for renovation materials can stymie efforts for renovation recycling. There is a definitive lack of case studies for communicating the value of renovation recycling. There is no societal cost accounting nor are there adequate consumer and business education programs that inform audiences about the economic, social and environmental benefits of renovation recycling. Greenwashing and confusion over recycling limit adoption as does general inertia to changing established disposal practices.

- Pre-planning of recycling activities

Without planning, the costs for renovation recycling may increase. This is particularly the case when contractors or haulers bid for disposal and then have to adjust their practice to incorporate separate steps for recycling. Every time a material is handled, it adds costs to the project.

- Market barriers

In terms of market, there is neither consistent supply of material nor consistent demands for material. This lack of sources and outlets conveys risk to firms that seek to participate in renovation recycling. The low value of typical renovation materials makes it difficult to transport them long distances or invest heavily in capital equipment to process the material or adjust manufacturing. Low tipping fees also affect supply and demand when disposal is cheap therefore limiting supply potential.

- Product design for reuse/recycling

Current materials are not designed for ease of reuse or recycling. The components of the materials in addition to any adhesives, paint and other contaminants affect the feasibility of reusing or recycling the material.

Policy and best practices

The Policy and Best Practice sessions gave participants an overview of what is and what can be done through government initiatives and through private initiatives to promote renovation recycling. As any project must be contextualized within the region, The Environmental Protection Agency and the State of Georgia Pollution Prevention Division representatives outlined existing government sponsored programs and initiatives. The County and City of San Francisco representative presented specifically what conditions the region has to overcome in terms of barriers and what programs San Francisco designed to overcome these challenges. The Best Practices presentations offered a series of case studies in which a variety of solutions were utilized to overcome local barriers. These solutions helped to stimulate “out of the box” thinking for the participants.

Development of solutions from afternoon sessions

The afternoon sessions were intended to identify specific inter-industry solutions to the one of the barriers identified from the morning sessions (see above). In the breakout sessions, the participants were asked to brainstorm potential synergies within four small breakout groups. The groups convened and presented a set of solutions.

Logistics Costs

To drive down the costs of recycling, the groups concurred that it was important to identify economies of scale. Some of the potential means for improving these economies of scale are to (1) create a brokerage system where companies would have to be qualified or certified to be a member of the system. The brokerage system would facilitate supply and demand of materials, much like a materials exchange but with more consistency in quality and volume.

Regional collection sites would help to defray logistics costs. Because transportation costs can render recycling infeasible, regional facilities could store materials until economies of scale would make pick-up cost effective. Some concerns over regional sites were policy-related. First, existing government policy may not allow for the collection and storage of materials without guaranteed markets as abandonment of such collection sites would result in illegal dump sites creating cost and hazards to the local community for clean-up. A clear business plan would be required detailing specific materials outlets. A possibility discussed was that large waste companies that already have permits might be interested in serving as collection sites.

As a part of the logistical chain, well-defined markets must be established. Regional users for materials would address transportation costs and low value materials. New markets should be sought where alternate industry consumers would be identified. This will require research and development for the specific materials.

Infrastructure Costs

Infrastructure adequacy and costs were addressed with the recommendations that regional collection, sorting and allocation be considered. These regional facilities would be cheaper and offer better coverage throughout the country. A detailed analysis would be conducted to determine site selection along with an agreement between industry participants to cooperate. Landfill owners would diversify into recycling. This diversification would enable the landfill owners to still obtain revenue from the material streams.

A way to increase demand to support the infrastructure would be to change the USGBC LEED standards to add recycling or use of recycled materials as a prerequisite and not an option. Education and communication to sell environmental benefits to owners and architects would also support the infrastructure investment (e.g., update the EPA WARM calculator to document environmental value of recycled materials). Case studies would help to raise awareness.

A construction waste management coordinator or consultant for projects would encourage higher efficiency (source separation), economies of scale from multiple projects, and planning and logistics for multiple streams.

Finally, industry cooperation is the key to ensuring success. With multiple firms collaborating there would be opportunities for joint collection financing, higher efficiency, more geographic coverage, less capital equipment and regional consolidation points.

Source Separation

The difficulty with source separation on job-sites is often space for multiple containers. One recommendation was that the material be source-separated but co-shipped so as to minimize space and time constraints. The supply chain structure would be focused on “delivering a quality product” from recovery through manufacture. This quality product would then support market development.

The supply chain for recycled materials relies heavily on standards. These standards would inherently be an incentive to avoid disposal, ensure high quality, and systematically avoid greenwashing. For example, contract language for the recovery team would specify recycling so as to avoid cost inflation.

The transfer of the recovered materials would involve the following steps: the material would be transferred through co-shipment to an intermediary (facility or brokerage). The intermediary would ensure quality through transparency, certification, and specification of the materials. The material, once quality assurance was achieved, would be sent to the producer/manufacturer.

Market Outlets

To develop the market for recycled renovation materials, the groups recommended a three point action plan. The first step was to develop a national database that listed outlets and contacts for each material. This database should reflect both the source and users of each material. The second approach was to utilize government influence by (1) implementing a material ban on renovation materials to drive recycling and (2) to use the purchasing power of government procurement to increase demand for recycled content products.

The second step was to identify completely new uses for recovered materials. This would require research and development activities.

The third step was to develop regional recycling models that minimize transport and handling while maximizing economic and environmental benefits.

Discussion of recommendations

Although each of the breakout groups tackled four different barriers, many of their solutions overlapped. Four key ideas emerged: (1) establishment of a regional clearinghouse or materials exchange; (2) regional processing; (3) new uses for materials; and (4) education and outreach.

Clearinghouse / Materials Exchange / Brokerage System

While there is no perfect information in the free market, there is a serious dearth of information regarding recovered material and potential markets. Some states have developed materials exchanges where companies can list materials available or wanted. The workshop participants found the concept of the materials exchange to be solid. However, to ensure adequate quality and quantity, the participants recommended a more structured system. This system would be in essence a clearinghouse where companies would be vetted to ensure quality of materials and thus avoid contamination. There would also be consistency in terms of quantity of material flow. Both quality and quantity are important for producers as they often adjust their equipment to handle recycled content and need to be assured that the materials will be available and clean.

In addition to having environmental impact, the clearinghouse or brokerage is an economic opportunity that will create jobs and generate revenue.

Regional Model / Eco Industrial Park

Regional solutions were consistently mentioned at the workshop. Regional collection and processing help to minimize transportation costs while encouraging local business development. When regional strategies are sought, there is the ancillary benefit of reducing economic leakage. Profits, tax revenue, and jobs will be generated in the area where the process/manufacturing takes place, thus perhaps incentivizing local governments to participate in development of the necessary infrastructure and related policies to support these endeavors.

Regional recycling activity can also generate by-product synergies similar to the eco-industrial park model. In this model, the wastes of one industry become the raw materials for another industry. Regional collection facilities can supply firms with necessary inputs for production.

New Uses

A necessary element discussed in the recommendations was the need for new uses for the recycled materials. Even for industries that can recycle recovered materials back into their products, only a limited amount can be used (e.g., drywall limitations are approximately 20%; vinyl tiles are limited to 20%). Down-cycling into alternative daily cover or fill material is a possibility but not the best use for the recovered materials. If new products are identified that

can use the recovered material, then down-cycling can be avoided. Furthermore, new products will increase demand leading to increased value for recycled goods.

Education and Outreach

A final recommendation that was consistent was the need to increase demand through education, outreach and preferred purchasing policies. Armed with the knowledge of why renovation recycling is important, architects, owners and contractors may be more likely to specify renovation recycling on their jobs. Preferred purchasing policies will increase demand for products, thus supporting market development.

Next steps

The workshop generated many ideas and enthusiasm for renovation recycling. The inter-industry synergies emerged as the participants were able to brainstorm potential solutions together. The next steps for cultivating the synergies are (1) to invite additional stakeholders to further develop solutions; (2) to develop a pilot program where the value chain puts into action the aforementioned recommendations; (3) to support innovation in renovation material reuse and recycling.

Additional Stakeholders

While this workshop was inclusive, it was not exhaustive of the potential stakeholders involved in renovation recycling. Additional stakeholders who need to be involved include: demolition contractors, construction material reuse association members, architects, retailers, real estate owners, and small companies that use recycled materials.

Pilot Program

Among the participants, there was enthusiasm for the concept of a pilot program. The pilot would have three objectives: (1) to detail life cycle costs on a case study; (2) quantify some of the more intangible benefits from recycling; and (3) identify outlets for certain materials that are difficult to recycle because of their low value.

Support for innovation

In order to encourage innovation in the field of reuse and recycling of renovation materials, there must be financial support for research and development of new products. This support may be in the form of competitions (e.g., in the vein of the EPA Life Cycle Building Challenge or Recycle Mania) or in grants to research labs and product development centers.

Appendix: List of Invited Participants and Workshop Attendees

Invited Participants

Greg Adams, Board of Regents
Tony Alvarez, Milliken
Amanda Atkinson, Holder Construction
Fried Augenbroe, Georgia Tech
Townsend Bailey, Sustainable Atlanta
Karen Bandhauer, EPA
Jim Birmingham, Waste Management
Chuck Boelkins, P2AD
Mort Borlaz, NCSU
Sharon Brittain, Board of Regents
Michael Buono, EMSG
Jeff Carrier, CRI
Dennis Creech, Southface
Adam Deck, Southface
Russ DeLozier, Shaw Industries
Paul Devereux, Arbor Carpets
Gregory Dick, CIWMB
Roy Edwards, P2AD
Frank Endrenyi, Mohawk
Ozlem Ergun, Georgia Tech
Fareed Farhut, CIWMB
Mark Ferguson, Georgia Tech
Aria Finkelstein, Sustainable Atlanta
John Fitzgerald, Gypsum Recycling America
Jennifer Gaalswyk, Armstrong
Russell Gentry, Georgia Tech
Bill Gregory, Milliken
Ron Greitzer, Los Angeles Fiber
Brad Guy, BMRA
Lauren Heberle, EPA EFC
Arpad Horvath, NCSU
Frank Hurd, CRI/CARE
Christopher Jarrett, Georgia Tech
Roozbeh Kangari, Georgia Tech
Charles Kibert, University of Florida
Dave Kitts, Mannington
Kasey Kruse, Kruse
Nancey Green Leigh, Georgia Tech
Harvey Levitt, DWSWMA
Richard Ludt, Interior Removal Specialists
Jim Mabes, Winter Construction

Diane Martel, Tarkett
Matt McKinney, IRN
Richard Murlin, USG
Eric Nelson, InterfaceFlor
Brad Nemeth, USG
Sandra Neuse, Board of Regents
Lynn Patterson, Kennesaw State University
Bob Peoples, Green Chemistry Institute
Pace Pickel, USG
Cynthia Poselenzny, Patterson Services
Sean Ragiel, CarpetCycle
Ellen Raynor, Carpet Recycler
Matthew Realff, Georgia Tech
Bourke Reeve, Southface
Louis Renbaum, Foam Recycle Center
Chris Ryan, Hogan Construction
Valena Scott, Sustainable Atlanta
Ron Sherga, Sher-Results
Steve Smith, EPA
Anita Snader, Armstrong
Anthony Spencer, Fulton County
Jeremy Stroop, CARE
Dean Thompson, RFCI
Beril Toktay, Georgia Tech
Ryan Trainer, Sleep Products
Jorge Vanegas, Texas A & M
Randy Waskul, Mohawk
Mary Williams, City and County of San Francisco
Winston Williams, Turner Construction
John Wuichet, Army Installation Management Agency

Student Participants

Andrew Harris, Georgia Tech
Vishal Agrawal, Georgia Tech
Maureen Foley, Georgia Tech
Yannis Bellos, Georgia Tech

Workshop Attendees

Tony Alvarez, Milliken
Amanda Atkinson, Holder Construction
Karen Bandhauer, EPA
Jim Birmingham, Waste Management
Michael Buono, EMSG
Jeff Carrier, CRI
Adam Deck, Southface
Russ DeLozier, Shaw Industries
Roy Edwards, P2AD
Frank Endrenyi, Mohawk
Mark Ferguson, Georgia Tech
Aria Finkelstein, Sustainable Atlanta
Maureen Foley, Georgia Tech
Jennifer Gaalswyk, Armstrong
Bill Gregory, Milliken
Ron Greitzer, Los Angeles Fiber
Dave Kitts, Mannington
Nancey Green Leigh, Georgia Tech
Andrew Harris, Georgia Tech
Harvey Levitt, DWSWMA
Jim Mabes, Winter Construction
Diane Martel, Tarkett
Matt McKinney, IRN
Richard Murlin, USG
Eric Nelson, InterfaceFlor
Brad Nemeth, USG
Sandra Neuse, Board of Regents
Lynn Patterson, Kennesaw State University
Bob Peoples, Green Chemistry Institute
Pace Pickel, USG
Cynthia Poselenzny, Patterson Services
Sean Ragiel, CarpetCycle
Ellen Raynor, Carpet Recycler
Matthew Realff, Georgia Tech
Chris Ryan, Hogan Construction
Ron Sherga, Sher-Results
Steve Smith, EPA
Anita Snader, Armstrong
Anthony Spencer, Fulton County
Jeremy Stroop, CARE
Dean Thompson, RFCI
Beril Toktay, Georgia Tech
Mary Williams, City and County of San Francisco
Winston Williams, Turner Construction